

A new species of *Neoseiulus* Hughes, with records of seven species of predatory mites associated with date palm in Saudi Arabia (Acari: Phytoseiidae)

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Abstract

Eight species of phytoseiid mites are reported from date palm orchards in Saudi Arabia. Seven of them were first records for this country: *Neoseiulus bicaudus* (Wainstein), *N. conterminus* (Kolodochka), *N. makuwa* (Ehara), *N. rambami* (Swirski & Amitai), *Proprioseiopsis asetus* (Chant), *P. messor* (Wainstein), *P. ovatus* (Garman). *Neoseiulus makuwa* and *P. asetus* are recorded from the Middle East and North Africa for the first time. One new species is described from Bermuda grass, *Neoseiulus saudiensis* n. sp. The new species is most similar to *Neoseiulus alpinus* (Schweizer) and *N. marginatus* (Wainstein). A key for identification of the included species is provided.

Key words: Acari, Mesostigmata, Phytoseiidae, biological control, predatory mites, *Neoseiulus saudiensis*, Saudi Arabia.

Introduction

The predatory mite family Phytoseiidae contains most of the species presently used as biological control agents of mite pests (Kostiainen & Hoy, 1996; McMurtry & Croft, 1997). The fauna of Phytoseiidae in Saudi Arabia is very poorly known, with only ten species previously recorded (Dabbour & Abdel-Aziz, 1982; Al-Shammery, 2010; Al-Atawi, 2011a,b; Fouly & Al-Rehiyani, 2011). Projects are underway to identify the fauna of phytoseiid mites in Saudi Arabia and select the species that may have potential as biological control agents.

In Saudi Arabia, date palm is an economic plant that is attacked by several pests. Among these is the old world date mite *Oligonychus afrasiaticus* (McGregor, 1939) (Acari: Tetranychidae), which affects the quality of the product and downgrades its value on the market. The present study was intended to identify the predatory mites in date palm orchards, mainly in Riyadh region, and recommend promising species for further studies.

Material and methods

Orchards were sampled for predatory mites over two years (2010–2011). Tullgren funnels or/and direct observation under a stereoscopic microscope (SZX10, Olympus®, Japan) were used to extract the mites from the plant material. Sampling included herbs and weeds growing in the orchards. Mites on weeds were sampled by using specialised hand-held aspirators (BioQuip®, CA, USA) after modifying the collecting chamber by adding a small piece of light cloth. The collected specimens were cleared in Nesbitt's solution, mounted in Hoyer's medium on glass slides, dried on a hot plate, ringed with nail polish and examined under a phase-contrast microscope (BX51, Olympus®). Measurements were taken with a graded eyepiece and illustrations were made using a drawing tube attached to the microscope. Identification was carried out according to Chant & McMurtry (2003, 2005, 2007). Setal nomenclature follows that of Rowell *et al.* (1978) and Chant & Yoshida-Shaul (1991) for dorsal and ventral surfaces of the idiosoma, respectively. Notation of idiosomal poroidotaxy follows Athias-Henriot (1975). All measurements are in micrometres (µm) and presented as means followed by the range (in parentheses). The type material and voucher

specimens were deposited at King Saud Museum of Arthropods, Riyadh (KSMA). One paratype female was deposited at the National Insect and Mite Collection of the National Museum of Natural History (USNM), Smithsonian Institution located in Beltsville, Maryland, USA and one paratype female at the Agriculture Research Council, Plant Protection Research Institute, Biosystematics Division, Pretoria, South Africa (ARC-PPRI). All paratypes have the same data as the holotype.

Family Phytoseiidae Berlese, 1913

Subfamily Amblyseinae Muma, 1961

Tribe Neoseiulini Chant & McMurtry, 2003

***Neoseiulus* Hughes, 1948**

Species group *barkeri* Chant & McMurtry, 2003

Species subgroup *womersleyi* Chant & McMurtry, 2003

***Neoseiulus saudiensis* n. sp.**

(Figures 1–5)

Female (Figures 1–5) (n=5)

Dorsal idiosoma (Figure 1). Dorsal shield 330 (324–337) long and 172 (165–180) wide at *j6* level, completely reticulated, with 17 pairs of smooth dorsal setae except for *Z4* and *Z5*, which are slightly serrate, and two pairs of lateral setae. Seven pairs of solenostomes present, *gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*. Lengths of dorsal setae: *j1* 20 (18–21), *j3* 30 (29–31), *j4* 23 (22–25), *j5* 23 (23–24), *j6* 25 (24–27), *J2* 30 (29–30), *J5* 12 (12–13), *z2* 30 (30–31), *z4* 29 (28–29), *z5* 23 (23–24), *Z1* 28 (26–29), *Z4* 49 (48–50), *Z5* 69 (68–70), *s4* 40 (39–41), *S2* 37 (36–39), *S4* 34 (32–36), *S5* 31 (30–33) and lateral setae *r3* 26 (25–28), *R1* 27 (26–29). Peritreme extending to *j1* level (Figure 1).

Ventral idiosoma (Figure 2). Sternal shield slightly reticulated, 63 (61–65) long (*ST1*–*ST3*) and 55 (54–58) wide at *ST2* level, straight posterior and convex anterior margins, with three pairs of setae and two pairs of poroides (*iv1*–*2*). Setae *ST1* 26 (26–27), *ST2* 27 (27–28), *ST3* 26 (25–27) and *ST4* 28 (28–29) and a pair of poroides on metasternal shields. Genital shield 57 (56–58) wide at *ST5* level, setae *ST5* 27 (26–27), paragenital poroides located on soft integument between setae *ST5* and *ZVI*, posterior margin straight. Two pairs of metapodal shields present, primary 30 (29–32) and accessory 9 (9–10). Ventrianal shield 120 (118–121) along midline and 90 (88–92) wide at *ZV2* level, reticulate, with three pairs of preanal setae *JV1* 24 (24–25), *ZV2* 25 (25–26), *JV2* 23 (22–24) and a pair of well separated glandular pores posteromesad to *JV2*, distance between these pores 26 (26–27). Four pairs of smooth opisthogastric setae around the ventrianal shield *ZV1* 21 (20–22), *ZV3* 19 (18–20), *JV4* 22 (21–23), *JV5* 53 (51–54)-slightly serrate.

Spermatheca. Calyx of spermatheca saccular 21 (20–22) long, narrow neck connecting calyx with forked atrium (Figure 3).

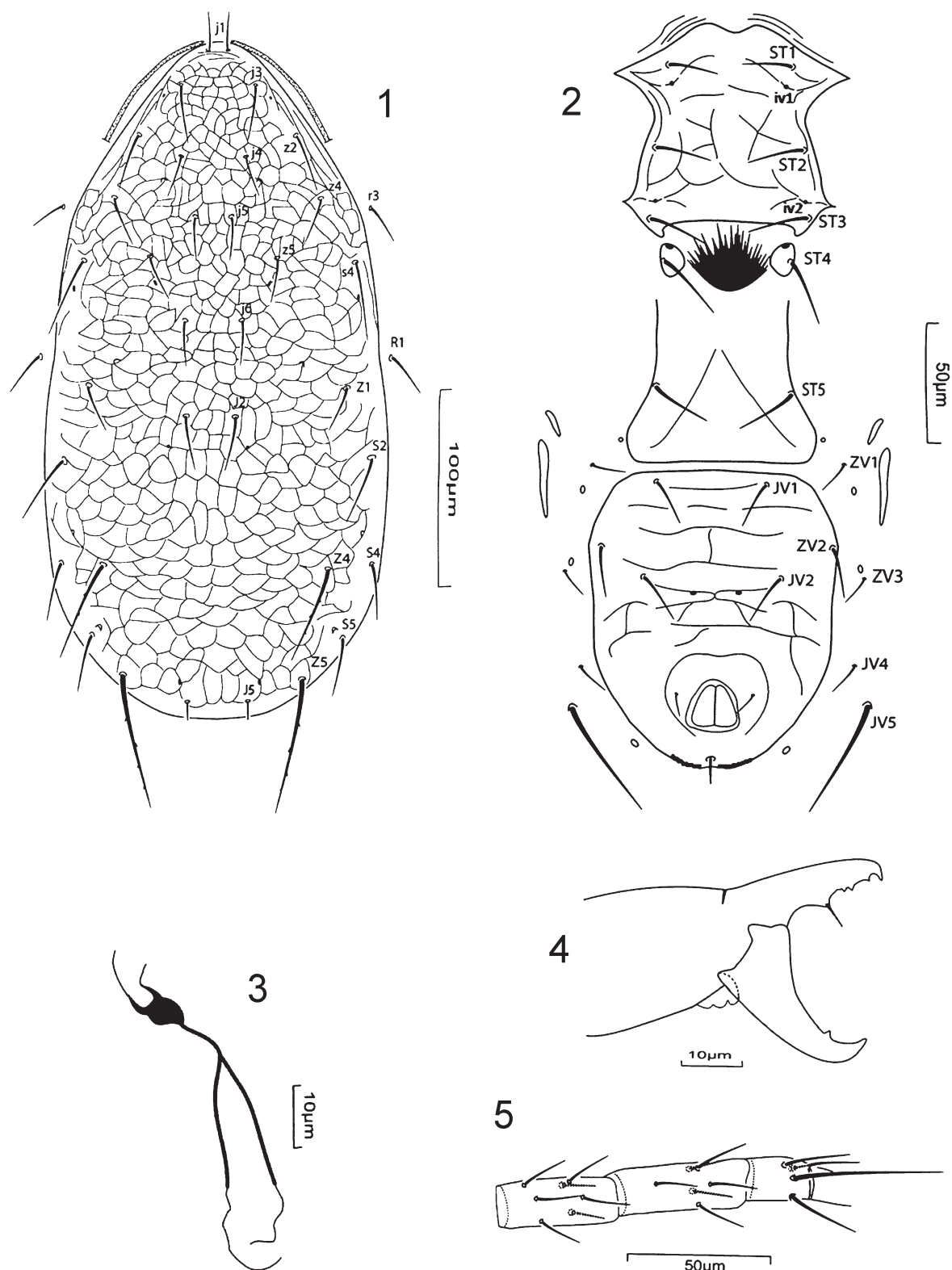
Chelicera (Figure 4). Movable digit 25 (25–26) long with one tooth; fixed digit 27 (26–28) long with three teeth and a pilus dentilis 4 (4–5) long.

Legs. One pointed macroseta on basitarsus IV 53 (50–56) (Figure 5); genua and tibiae I–IV with 10–7–7–7 and 10–7–7–6 setae, respectively.

Etymology. The name *saudiensis* refers to the country where the type specimens were collected.

Specimens examined. Holotype female and 24 paratype females, on aerial part of Bermuda grass, *Cynodon dactylon* (L.) Pers. (Poaceae) in a date palm orchard, Dereiya, Riyadh region, Saudi Arabia, 24° 42' N, 46° 37' E, alt. 645 m, 19 November 2010, coll. Mohamed W. Negm. Holotype and 22 paratypes deposited at King Saud Museum of Arthropods (KSMA); 1 paratype female at the National Insect and Mite Collection of the National Museum of Natural History (USNM), Smithsonian Institution, Beltsville, Maryland, USA; 1 paratype female at the Agriculture Research Council, Plant Protection Research Institute, Biosystematics Division, Pretoria, South Africa (ARC-PPRI).

Remarks. This species is characterised by the following combination of characters: dorsal shield completely reticulated, sternal shield slightly reticulated, peritreme extending to *j1* level, calyx of spermatheca saccular and connected to a forked atrium with long narrow neck.



FIGURES 1–5. *Neoseiulus saudiensis* Negm, Alatawi & Aldryhim **n. sp.** Female, 1. idiosoma dorsum, 2. idiosoma venter, 3. spermatheca, 4. chelicera, 5. genu, tibia and basitarsus IV.

The new species belongs to the *barkeri* species group and the *womersleyi* species subgroup as defined by Chant & McMurtry (2003). *Neoseiulus alpinus* (Schweizer, 1922) and *Neoseiulus marginatus* (Wainstein, 1961) are similar to this new species. However, *Neoseiulus saudiensis* **n. sp.** differs from the former by having all dorsal setae much longer, sternal shield straight posteriorly, a longer neck between the calyx and atrium, and it differs

from the latter in having longer anterodorsal setae (*j3, j4, j5, j6, J2, z2, z4, z5, Z1, s4*), completely reticulated dorsal shield, narrower and longer neck between calyx and atrium, and shorter macroseta St IV. The new species was compared with redescrptions of *N. marginatus* by Palevsky *et al.* (2009) and Faraji *et al.* (2011) on the specimens collected from Israel and Turkey, respectively.

Species group *cucumeris* Chant & McMurtry, 2003

Species subgroup *paraki* Chant & McMurtry, 2003

***Neoseiulus bicaudus* (Wainstein)**

Amblyseius bicaudus Wainstein, 1962: 146.

Neoseiulus bicaudus.— Chant & McMurtry, 2003: 23; 2007: 25; Moraes *et al.*, 2004: 108; Palevsky *et al.*, 2009: 1729; Asali Fayaz *et al.*, 2011: 375.

Specimens examined. One female, Ouyaina, Riyadh, 17 March 2010, 24°53' N, 46°21' E, alt. 740 m, on Garden nasturtium, *Tropaeolum majus* L. (Tropaeolaceae) in a date palm orchard.

Remarks. The type specimens of this species were collected from grass at Kargalink, Alma-Ata, Kazakhstan. The Saudi specimen is very similar to the redescription done by Palevsky *et al.* (2009) who illustrated genu IV (Fig. 6E) with six setae. However, genu IV has seven setae in the Saudi specimen. This is the first record of this species in Saudi Arabia. This species occurs in Armenia, Azerbaijan, Caucasus, France, Georgia, Greece, Hungary, Israel, Italy, Moldova, Norway, Russia, Serbia, Spain, Switzerland, Tajikistan, Turkey, Ukraine, USA (Moraes *et al.*, 2004) and Iran (Asali Fayaz *et al.*, 2011).

Species group *cucumeris* Chant & McMurtry, 2003

Species subgroup *paraki* Chant & McMurtry, 2003

***Neoseiulus conterminus* (Kolodochka)**

Amblyseius conterminus Kolodochka, 1990: 161.

Neoseiulus conterminus.— Chant & McMurtry, 2003: 23; Moraes *et al.*, 2004: 114; Chant & McMurtry, 2007: 25; Palevsky *et al.*, 2009: 1727.

Specimens examined. One female, Dereiya, Riyadh, 9 June 2010, 24°44' N, 46°34' E, alt. 670 m, on Bindweed, *Convolvulus arvensis* L. (Convolvulaceae) in a date palm orchard.

Remarks. The type specimens were collected from soil at Karakalpak, Uzbekistan while the Saudi specimen was found on *Convolvulus arvensis* leaves. Our specimen of *N. conterminus* agrees with the redescription given by Palevsky *et al.* (2009) for two female specimens collected from *Cynodon dactylon* in date palm orchards, Israel. This species is a new record for the Saudi mite fauna. This species has been recorded from Israel and Uzbekistan.

Species group *barkeri* Chant & McMurtry, 2003

Species subgroup *womersleyi* Chant & McMurtry, 2003

***Neoseiulus makuwa* (Ehara)**

Amblyseius (*Amblyseius*) *makuwa* Ehara, 1972: 154.

Amblyseius makuwa.— Wu *et al.*, 1991: 89.

Amblyseius (*Neoseiulus*) *makuwa*.— Ehara and Amano, 1998: 37.

Neoseiulus makuwa.— Chant & McMurtry, 2003: 37; Moraes *et al.*, 2004: 131; Zannou *et al.*, 2006: 261; Chant & McMurtry, 2007: 29.

Specimens examined. Three females, Dereiya, Riyadh, 19 May 2011, 24°44' N, 46°34' E, alt. 678 m, on Sea-purslanes, *Sesuvium* sp. (Aizoaceae) in a date palm orchard.

Remarks. The type specimens were found on *Cucumis melo* var. *makuwa* at Kita-usa, Usa, Oita, Kyushu, Japan. The Saudi specimens completely agree with the redescription of *N. makuwa* given by Zannou *et al.* (2006), who reported one female specimen for the first time in Africa (Cameroon), on *Ageratus conyzoides*. This is the first record of this species in Saudi Arabia, as well as in the Middle East and North Africa. This species has also been recorded in China, Indonesia (Sumatra), Japan, South Korea, Taiwan (Ehara and Amano, 2004; Moraes *et al.*, 2004); Cameroon (Zannou *et al.*, 2006).

Species group *paspalivorus* Chant & McMurtry, 2003

***Neoseiulus rambami* (Swirski & Amitai)**

Amblyseius rambami Swirski & Amitai, 1990: 117.

Neoseiulus rambami, Chant & McMurtry, 2003: 27; 2007: 29; Palevsky *et al.*, 2009: 1724.

Specimens examined. Five females, Alhasa region, 26 October 2011, 25°22' N, 49°34' E, alt. 160 m, three specimens on the pinnate leaves of *Phoenix dactylifera* L. (Arecaceae) and two on *Cynodon dactylon*.

Remarks. The type specimens of *Neoseiulus rambami* were found on *Ficus religiosa*, Tiberias, Israel (Swirski & Amitai, 1990). Morphological characteristics of the Saudi specimens are very close to those as redescribed by Palevsky *et al.* (2009). The only remarkable difference is that Palevsky *et al.* (2009, Fig. 4E) illustrated genu IV with six setae. However, genu IV has seven setae in the Saudi specimen. Males are described for the first time by Palevsky *et al.* (2009). This is the first record of this species in Saudi Arabia, and it is otherwise known only from Israel.

Tribe Amblyseiini Wainstein, 1962

Subtribe Proprioseiopsina Chant & McMurtry, 2005

***Proprioseiopsis* Muma, 1961**

Species group *belizensis* Chant & McMurtry, 2005

Species subgroup *asetus* Chant & McMurtry, 2005

***Proprioseiopsis asetus* (Chant)**

Typhlodromus (*Amblyseius*) *asetus* Chant, 1959: 80.

Amblyseiulus asetus.— Muma, 1961: 278.

Proprioseiopsis asetus.— Foully *et al.*, 1994: 205; Moraes *et al.*, 2004: 171; Chant & McMurtry, 2005: 13; 2007: 89.

Specimens examined. One female, three males, Dereiya, Riyadh, 17 March 2011, 24°44' N, 46°34' E, alt. 675 m, on *Cynodon dactylon* in a date palm orchard; one female, Ouyaina, Riyadh, 08 May 2011, 24°54' N, 46°23' E, alt. 736 m, on Nettle-leaved goosefoot, *Chenopodium murale* L. (Amaranthaceae) in a date palm orchard.

Remarks. The original description of *P. asetus* is based on material collected from apple, at Kearneysville, West Virginia, USA. Muma *et al.* (1970) recorded and described the males and females of 16 species in Florida including *P. asetus*. Our specimens of *P. asetus* agree with the data provided by Foully *et al.* (1994) on the specimens collected in debris samples under "Hamlin" orange trees at Fellsmere, Indian River County, Florida. According to the redescription provided by Foully *et al.* (1994, Figs. 29, 31), the genua and tibiae II–IV have 10–6 and 7–7 setae, respectively. However, the examined Saudi specimens have genua and tibiae II–IV with 8–7 and 7–6 setae, respectively. A description of larvae, protonymphs and deutonymphs of *P. asetus* including ontogenetic development of the idiosomal setae was given by Foully *et al.* (1994). This is the first record of this species in Saudi Arabia, as well as in the Middle East and North Africa. It is otherwise known from Brazil, Galapagos, Hawaii, Jamaica, Mexico, Taiwan, USA (Moraes *et al.*, 2004).

Species group *belizensis* Chant & McMurtry, 2005
Species subgroup *belizensis* Chant & McMurtry, 2005

***Proprioseiopsis messor* (Wainstein)**

Typhlodromus messor Wainstein, 1960: 688.

Amblyseius messor.—Athias-Henriot, 1961: 425.

Amblyseius (*Amblyseius*) *messor*.—Ueckermann & Loots, 1988: 66.

Proprioseiopsis messor.—Moraes *et al.*, 2004: 180; Chant & McMurtry, 2005: 15; 2007: 89; Moraes *et al.*, 2007: 16.

Specimens examined. Four females, Dereiya, Riyadh, 29 March 2011, 24°43' N, 46°37' E, alt. 674 m, on Orchid tree, *Bauhinia variegata* L. (Fabaceae) in a date palm orchard.

Remarks. Specimens of *Proprioseiopsis messor* were found on *Bauhinia variegata* close to the soil surface. Mites were found associated with thrips (Insecta). The Saudi specimens of *P. messor* agree with the data provided by Moraes *et al.* (2007) for two specimens collected in sub-Saharan Africa (South Africa). This species is a new record for the Saudi mite fauna. It has previously been recorded from Algeria, Armenia, Australia, Azerbaijan, France, Gaza Strip, Georgia, Germany, Greece, Israel, Italy, Morocco, New Zealand, South Africa, Spain, Turkmenistan, Ukraine (Moraes *et al.*, 2004); Argentina (Ruiz *et al.*, 2005).

Species group *belizensis* Chant & McMurtry, 2005
Species subgroup *belizensis* Chant & McMurtry, 2005

***Proprioseiopsis ovatus* (Garman)**

Amblyseiopsis ovatus Garman, 1958: 78.

Typhlodromus (*Amblyseius*) *ovatus*.—Chant, 1959: 90.

Amblyseiulus ovatus.—Muma, 1961: 278.

Proprioseiopsis ovatus.—Moraes *et al.*, 2004: 184; Chant & McMurtry, 2005: 15; 2007: 89; Moraes *et al.*, 2007: 19; Faraji *et al.*, 2008: 109.

Specimens examined. One female, one male, Ouyaina, Riyadh, 01 November 2010, 24°54' N, 46°23' E, alt. 736 m, on Fig, *Ficus carica* L. (Moraceae) in a date palm orchard; 11 females, Al-Imam Mohamed Bin Saud Islamic University, Riyadh, 20 April 2011, 24°49' N, 46°42' E, alt. 657 m, on *Sesuvium* sp., in a date palm orchard; 12 females, 27 males, Unaiza, Qassim region, 25 May 2011, 26°04' N, 43°59' E, alt. 683 m, on *Cynodon dactylon*, in a date palm orchard; 3 females, Nadec company, Wadi Al-Dawaser, 06 July 2011, 20°20' N, 45°08' E, alt. 308 m, on *Phoenix dactylifera*.

Remarks. The holotype of *Proprioseiopsis ovatus* was collected on *Cattleya* sp. from Ecuador, intercepted at Brownsville, Texas, USA and deposited in United States National Museum. The specimens of *P. ovatus* in this study resemble those redescribed by Moraes *et al.* (2007) and Faraji *et al.* (2008), which were collected from sub-Saharan Africa and Spain, respectively. This is the first record of this species in Saudi Arabia. The species is also known from Brazil, Costa Rica, Cuba, Ecuador, Egypt, Ghana, Hawaii, Honduras, Kenya, Philippines, Puerto Rico, Sierra Leone, South Africa, Taiwan, USA, Zimbabwe (Moraes *et al.*, 2004; Moraes *et al.*, 2007); Spain (Faraji *et al.*, 2008).

Key to species of the Phytoseiidae treated in this paper

- | | | |
|----|---|------------------------------------|
| 1. | Setae J2 present | <i>Neoseiulus</i> Hughes...2 |
| - | Setae J2 absent | <i>Proprioseiopsis</i> Muma...6 |
| 2. | Spermatheca with atrium forked at juncture with major duct. | 3 |
| - | Spermatheca with atrium not forked at juncture with major duct. | 4 |
| 3. | Calyx trumpet-shaped, genu IV with macroseta | <i>N. makuwa</i> (Ehara) |
| - | Calyx saccular, genu IV without macroseta | <i>N. saudiensis</i> n. sp. |
| 4. | Calyx of spermatheca bell-shaped; atrium moderately elongate | <i>N. conterminus</i> (Kolodochka) |

- Calyx of spermatheca bowl-shaped; atrium nodular. 5
- 5. Stalk clearly present between the calyx and atrium; seta Z5 longer than 75µm, movable digit of chelicera with one tooth *N. bicaudus* (Wainstein)
- Stalk hardly seen between calyx and atrium; seta Z5 shorter than 75µm, movable digit with two teeth *N. rambami* (Swirski & Amitai)
- 6. Calyx of spermatheca pocular *P. aetus* (Chant)
- Calyx of spermatheca saccular 7
- 7. Sternal shield smooth at the central region; all surface of genital shield smooth; atrium of spermatheca compact to base of the calyx; internal surface of calyx base appears convex *P. messor* (Wainstein)
- Sternal shield reticulate at the central region; genital shield with lateral striae; atrium nodular; internal surface of calyx base is normally rounded *P. ovatus* (Garman)

Discussion

The current study is the most comprehensive study that has been conducted on the phytoseiid fauna in Saudi Arabia. The new species and the seven new records may indicate that this area is rich in phytoseiid species. Moreover, recording *Neoseiulus makuwa* and *Proprioiseiopsis aetus* for the first time in the Middle East as an alien species may show that phytoseiid mites could work well as biological control agents in this semi-arid area. Therefore, further and extensive studies are recommended for phytoseiid mites on other plant species.

Acknowledgements

The authors are very grateful to Drs. Farid Faraji (MITOX Consultants, Amsterdam, The Netherlands) and James A. McMurtry (University of California, Riverside, Sunriver, Oregon, USA) for examining the new species and for their useful comments. Again, we would like to thank Dr. Farid Faraji for confirmation of the species identification. The senior author is grateful to Ronald Ochoa (USDA-ARS-SEL, USA); Gamal Basahih, Abdelgayed Salah (King Saud University, Saudi Arabia) for their help and continuous encouragements.

References

- Al-Atawi, F.J. (2011a) Phytophagous and predaceous mites associated with vegetable crops from Riyadh, Saudi Arabia. *Saudi Journal of Biological Sciences*, 18, 239–246.
- Al-Atawi, F.J. (2011b) Six new records of predaceous mites associated with trees from Riyadh, Saudi Arabia. *Acarines*, 5, 37–39.
- Al-Shammery, K.A. (2010) Different biological aspects of the predaceous mite *Euseius scutalis* (Acari: Gamasida: Phytoseiidae) and the effects due to feeding on three tetranychid mite species in Hail, Saudi Arabia. *Asian Journal of Biological Sciences*, 3, 77–84.
- Asali Fayaz, B., Khanjani, M. & Ueckermann, E.A. (2011) Description of immature stages and redescription of female and male of *Neoseiulus bicaudus* (Wainstein, 1962) (Acari: Phytoseiidae) from West of Iran. *Acta Phytopathologica et Entomologica Hungarica*, 46, 329–338.
- Athias-Henriot, C. (1961) Mésostigmates (Urop. Excl.) édaphiques Méditerranéens (Acaromorpha, Anactinotrichida). *Acarologia*, 3, 381–509.
- Athias-Henriot, C. (1975) Nouvelles notes sur les Amblyseiini. II. Le relevé organotaxique de la face dorsale adulte (Gamasides Protoadeniques, Phytoseiidae). *Acarologia*, 27, 20–29.
- Chant, D.A. (1959) Phytoseiid mites (Acarina: Phytoseiidae) Part I. Bionomics of seven species in Southeastern England. Part II. A taxonomic review of the family Phytoseiidae, with descriptions of 38 new species. *Canadian Entomologist*, 91 (suppl. 12), 1–166.
- Chant, D.A. & McMurtry, J.A. (2003) A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae). Part I. Neoseiulini new tribe. *International Journal of Acarology*, 29, 3–46.
- Chant, D.A. & McMurtry, J.A. (2005) A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part V. Tribe Amblyseiini, Subtribe Proprioiseiopsina Chant & McMurtry. *International Journal of Acarology*, 31, 3–22.
- Chant, D.A. & McMurtry, J.A. (2007) *Illustrated Keys and Diagnoses for the Genera and Subgenera of the Phytoseiidae of the World (Acari: Mesostigmata)*. Indira Publishing House, West Bloomfield, Michigan, 220 pp.
- Chant, D.A. & Yoshida-Shaul, E. (1991) Adult ventral setal patterns in the family Phytoseiidae (Acari: Gamasina). *International Journal of Acarology*, 17, 187–199.

- Dabbour, A.I. & Abdel-Aziz, M.I. (1982) Scientific note on Acarina in Saudi Arabia. *Journal of College of Agriculture, King Saud University*, 4, 113–116.
- Ehara, S. (1972) Some phytoseiid mites from Japan, with descriptions of thirteen new species (Acarina: Mesostigmata). *Mushi*, 46, 137–173.
- Ehara, S. & Amano, H. (1998) A revision of the mite family Phytoseiidae in Japan (Acari: Gamasina), with remarks on its biology. *Species Diversity*, 3, 25–73.
- Ehara, S. & Amano, H. (2004) Checklist and keys to Japanese Amblyseiinae (Acari: Gamasina: Phytoseiidae). *Journal of the Acarological Society of Japan*, 13, 1–30.
- Faraji, F., Bakker, F. & Roig, J. (2008) A new species and two new records of Phytoseiidae (Acari: Mesostigmata) from Spain. *Revista Ibérica de Aracnología*, 16, 105–111.
- Faraji, F., Cobanoglu, S. & Cakmak, I. (2011) A checklist and a key for the Phytoseiidae species of Turkey with two new species records (Acari: Mesostigmata). *International Journal of Acarology*, 37 (suppl. 1), 221–243.
- Fouly, H. & Al-Rehiyani, S.M. (2011) Predaceous mites in Al-Qassim Region, Saudi Arabia, with description of two new laelapid species (Acari: Gamasida: Laelapidae). *Journal of Entomology*, 8, 139–151.
- Fouly, A.H., Denmark, H.A. & Childers, C.C. (1994) Description of the immature and adult stages of *Proprioseiopsis rotundus* (Muma) and *Proprioseiopsis asetis* (Chant) from Florida (Acari: Phytoseiidae). *International Journal of Acarology*, 20, 199–207.
- Garman, P. (1958) New species belonging to the genera *Amblyseius* and *Amblyseiopsis* with keys to *Amblyseius*, *Amblyseiopsis* and *Phytoseiulus*. *Annals of the Entomological Society of America*, 51, 69–79.
- Kolodochka, L.A. (1990) Three new phytoseiid mite species (Parasitiformes). In: *Novosti maunistik I sistematiki [Faunistic and systematic news]*. Naukova Dumka, Kiev, Ukraine, 158–163.
- Kostiainen, T.S. & Hoy, M.A. (1996) *The Phytoseiidae as Biological Control Agents of Mite Pests and Insects. A Bibliography*. University of Florida, Gainesville. 355 pp.
- McGregor, E.A. (1939) The specific identity of the American date mite; Description of two new species of *Paratetranychus*. *Proceedings of the Entomological Society of Washington*, 41, 247–256.
- McMurtry, J.A. & Croft, B.A. (1997) Life-styles of phytoseiid mites and their roles in biological control. *Annual Review of Entomology*, 42, 291–321.
- Moraes, G.J. de, McMurtry, J.A., Denmark, H.A. & Campos, C.B. (2004) A revised catalog of the mite family Phytoseiidae. *Zootaxa*, 434, 1–494.
- Moraes, G.J. de, Zannou, I.D., Ueckermann, E.A., Oliveira, A.R., Hanna, R. & Yaninek, J.S. (2007) Species of the subtribes Arrenoseiina and Proprioseiopsina (Tribe Amblyseiini) and the tribe Typhlodromipsini (Acari: Phytoseiidae) from sub-Saharan Africa. *Zootaxa*, 1448, 1–39.
- Muma, H.M. (1961) Subfamilies, genera and species of Phytoseiidae (Acarina: Mesostigmata). *Bulletin of the Florida State Museum. Biological Sciences*, 5, 267–302.
- Muma, H.M., Denmark, H.A. & De Leon, D. (1970) *Phytoseiidae of Florida. Arthropods of Florida and Neighboring Land Areas*, Florida Department of Agriculture and Consumer Services, Gainesville. 150 pp.
- Palevsky, E., Gal, S. & Ueckermann, E.A. (2009) Phytoseiidae from date palms in Israel with descriptions of two new taxa and a key to the species found on date palms worldwide (Acari: Mesostigmata). *Journal of Natural History*, 43, 1715–1747.
- Rowell, H.J., Chant, D.A. & Hansell, R.I.C. (1978) The determination of setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae (Acarina: Mesostigmata). *Canadian Entomologist*, 110, 859–876.
- Ruiz, M.G., Sosa, D.H., Speranza, C., Lofego, A.C., Moraes, G.J. de & Fernandes, O.A. (2005) Phytoseiid mites (Acari: Phytoseiidae) from apple trees in Río Negro, Argentina. Short communication. *Spanish Journal of Agricultural Research*, 3, 437–438.
- Schweizer, J. (1922) Beitrag zur kenntni der terrestrischen milbenfauna der Schweiz. *Verhandlungen der Naturforschenden Gesellschaft*, 33, 23–112.
- Swirski, E. & Amitai, S. (1990) Notes on phytoseiid mites (Mesostigmata: Phytoseiidae) from the Sea of Galilee region of Israel, with a description of a new species of *Amblyseius*. *Israel Journal of Entomology*, 24, 115–124.
- Ueckermann, E.A. & Loots, G.C. (1988) The African species of the subgenera *Anthoseius* De Leon and *Amblyseius* Berlese (Acari: Phytoseiidae). *Entomology Memoir, Department of Agriculture and Water Supply*, Republic of South Africa, South Africa, 73, 168 pp.
- Wainstein, B.A. (1960) New species and subspecies of the genus *Typhlodromus* Scheuten (Parasitiformes, Phytoseiidae) of the USSR fauna. *Zoologicheskii Zhurnal*, 39, 683–690.
- Wainstein, B.A. (1961) New species of Acarina of the genus *Typhlodromus* (Parasitiformes, Phytoseiidae) in Georgia. *Trudy Instituta Zoologii Akademia Nauk Gruzinskoi SSR*, 18, 153–162.
- Wainstein, B.A. (1962) Some new predatory mites of the family Phytoseiidae (Parasitiformes) of the USSR fauna. *Entomologicheskoe Obozrenie*, 41, 139–146.
- Wu, W.N., Lan, W.M. & Liu, Y.H. (1991) Phytoseiid mites of lychee from China, and their value for application. *Natural Enemies of Insects*, 13, 82–91.
- Zannou, I.D., Moraes, G.J. de, Ueckermann, E.A., Oliveira, A.R., Yaninek, J.S. & Hanna, R. (2006) Phytoseiid mites of the genus *Neoseiulus* Hughes (Acari: Phytoseiidae) from sub-Saharan Africa. *International Journal of Acarology*, 32, 241–276.